Transportation Communications Interoperability:
Phase 1 - Needs Assessment

Introduction

ADOT's ability to successfully fulfill its responsibilities for day-to-day highway maintenance and construction, event traffic management, incident response, and regional security issues depends on reliable radio communications between its field units and with partner agencies. This Needs Assessment study represents an initial step in a comprehensive effort to improve statewide radio communications interoperability within the Department, and with ADOT's partner agencies.

No single radio frequency in the state currently fulfills the critical need for secure cross-channel communications between all ADOT Divisions and with transportation agency and emergency response partners of all levels. It is anticipated that systematic and coordinated equipment and infrastructure upgrades combined with shared and enforced communications protocols will overcome the lack of common radio frequencies, channels, or communications systems between agencies, and across jurisdictional boundaries.

The results of this research will help define effective transportation interoperability throughout Arizona, and will support ADOT's future planning, pilot project tests, and field deployments, both for operations and for local and regional incident response and command.

Study Objectives and Methodology

This research evaluated specific challenges to radio interoperability for ADOT and its partners and recommended incremental solutions to radio interoperability statewide, for routine operations as well as for incident response and command.

The project's objectives were to: (a) document the current state of communications interoperability within and between Arizona's transportation agencies; (b) identify potential deficiencies; (c) recommend potential solutions; (d) develop a test plan for the proposed solution.

The study approach reflected the multitude of radio interoperability stakeholders in Arizona. Information and opinions on interoperability needs, issues, and desired solutions was solicited from ADOT and its partners at focus groups in Phoenix, Kingman, Flagstaff, Holbrook, Safford, and Tucson, in online and mailed stakeholder surveys, and in a multiagency table-top exercise. Stakeholder input was analyzed to gain an assessment of existing interoperability conditions, needs, and likely recommendations of viable radio system configurations supporting the internal needs of ADOT as well as its partnership responsibilities.

Key Obstacles to Radio Interoperability

Several technical and operational issues inhibit ADOT's abilities for intra- and inter-operability.

Key technical obstacles include:

- Noncompatible radio bands of operation within and outside of ADOT Highways Division (ITD)
- Lack of interoperable channels programmed in ADOT and Motor Vehicle (MVD) radios
- Absence of common console-to-console interconnect channels with the Department of Public Safety (DPS)
- Obsolete 800 MHz ADOT mobile and portable radios
- Absence of direct telephone ring-down lines between ADOT and DPS
- Absence of ADOT Traffic Operations Center (TOC) dispatch console links to Maricopa County and Phoenix
- In-district only channels on most rural ADOT district dispatch consoles

Key operational obstacles include the lack of:

- Training and practice of ADOT's TOC dispatchers in console cross-patching
- Common mnemonics and identifiers between ADOT and others
- Written policies and procedures to initiate radio interoperability
- Intergovernmental radio agreements with other agencies
- Regular testing of existing interoperable systems

Recommended Solutions

The recommended short and mid-term solutions, and long-term strategies, aim to further four ADOT interoperability goals identified through this research project. These *key ADOT goals* are to achieve radio interoperability between:

I. All ADOT Highways Division Radios

II. Every MVD and Highways Division Radio

III. Every ADOT and DPS Radio

IV. Any ADOT Units Responding to Incidents and Other Agency Responders

Recommended technical and operational solutions vary widely in cost, complexity, and time to implement. The ultimate, long-term solution is a shared, statewide interoperable radio network serving State agencies and interconnected to local agencies.

The full deployment of a new statewide radio network is not anticipated before at least six years, according to another recent study, with a total estimated cost in excess of $350 million.

In the short term, ADOT should concentrate on solutions that build on existing equipment and systems. This would include reprogramming of the existing VHF radios of both ADOT Maintenance and Construction, and of the MVD. Reprogramming of existing radio units does not require new hardware and is moderately labor-intensive. Band-incompatibility with the DPS and 800 MHz radio users in Maricopa County can be overcome in the short-term by interconnecting channels on the TOC dispatch consoles to other agencies' dispatch consoles, which can then be cross-patched.

Availability of direct, instant communications between the TOC and DPS dispatch centers in Phoenix, Tucson, and Flagstaff is important. Telephone "ring-down" circuits can provide direct dispatcher-to-dispatcher communications – a more effective solution than a field unit broadcasting a message to a dispatch center on a radio channel that might not be selected by the dispatcher on their console. In addition, installation of unassigned dispatch console channels for TOC-DPS linked control circuits would allow the dispatchers to provide radio interconnection to DPS and ADOT units in the field in virtually any location.

Installing additional control channels in the dispatch consoles of adjacent rural ADOT districts would allow for much greater cross-channel patch capability, linking widely-separated Maintenance and Construction units.

Technical Recommendations

Some of the more viable and less costly technical solutions recommended for implementation in the short-term include:

Install dispatch console ring-down circuits between the Phoenix TOC and DPS - The ring-down circuits will allow TOC and DPS dispatchers to have instant critical communications capability. Flagstaff and Tucson circuits can be carried over the existing DPS microwave system.

Install "dark" cross-patch circuits between the TOC and DPS consoles - These circuits will allow TOC and DPS dispatchers to cross-patch any radio channels from each other's systems statewide, during special situations requiring interoperability on a short-term or emergency basis. Cross-patch circuits to the Phoenix and Maricopa County dispatch centers are also possible, to allow any ADOT trunked talk-group to be patched to a Phoenix or County channel.

Program ADOT VHF channels in all MVD mobile radios - MVD's lack of after-hours dispatch support can be resolved by programming some or all of the ADOT Maintenance system channels into their mobile radios. The TOC could then act as an after-hours back-up dispatch, assuming some issues of security can be worked out. Common VHF channels will also allow direct unit-to-unit contact between MVD officers and ADOT Maintenance and Construction personnel.

Program interoperable radio channels in ADOT Maintenance radios - Programming the National VHF Interoperable public safety radio channel into all ADOT and MVD radios will, as a minimum, provide direct, two-way communications with those rural agencies who also have radios programmed with this channel. Since most rural agencies still use VHF radios, this channel can be shared with a relatively large number of users.

Install additional ADOT channels in rural ADOT consoles to cross-patch - ADOT personnel on assignment in adjacent districts cannot radio directly to their own dispatcher and must communicate via the other district's dispatcher or the TOC. By installing several more radio channels of adjacent districts in the rural districts' dispatch consoles, this problem will be partially alleviated.

Operational Recommendations

The recommended technical improvements in hardware and equipment programming must be supported by several key operational solutions in order to succeed in the long-term. These include:

Re-write the ADOT Radio Communications Manual - The current manual is obsolete. Since its last publication, radio types have changed, statewide channels have changed to a degree, today's MVD radio system has changed dramatically, and the manual provides no guidance on interoperability with users outside of the "home" district.

Draft new Policies and Procedures *manual for dispatch personnel* - Common nomenclature for callsigns, making and answering calls, requests for cross-patching, and handling of radio traffic are essential for a successful interoperable radio system. All personnel having anything to do with the dispatch process should be trained in these procedures.

Periodic, Regular System Testing - Regular testing of radio systems in place is essential to keep dispatch operators and field personnel familiar with how to use the systems and to verify that cross-patch and other hardware remains functional at all levels.

Goal Detail and Cost Summary

The technical and operational solutions described here form the key activities of the four interoperability goals. Planning-level costs were estimated for each activity, and aggregated into sum total costs per goal.

Goal I focuses on improved interoperability between ADOT's Phoenix District Maintenance units (800 MHz radio) and the Maintenance units of surrounding Districts (VHF radio); and on improved communications between distant VHF Maintenance units. The planning-level estimated cost to achieve Goal I is $369,000.

Achieving Goal II will result in radio interoperability between MVD and the Highways Division (ITD) by programming the Highways channels into MVD vehicular radios statewide and includes new, effective communications procedures and ongoing training. Additionally, MVD's 24/7 access to dispatch radio can be accomplished by combining MVD dispatch on the TOC dispatch consoles. The Goal II estimated cost is $83,500.

Goal III will be achieved with (a) a ring-down telephone circuit from DPS Phoenix, Flagstaff, and Tucson dispatch centers to the TOC and (b) cross-patch fiber circuits between the TOC and the DPS Phoenix microwave room allowing

cross patching of DPS calls out of the Phoenix, Flagstaff, and Tucson dispatch centers to any ADOT statewide Highways (ITD) channel through the TOC consoles. In addition, ADOT should be allowed the use of the old VHF "State" channel on a shared basis for direct access to a DPS dispatcher, resulting in quicker access to a DPS officer by bypassing the ADOT TOC. The estimated cost for Goal III is $78,000.

Goal IV involves many agencies statewide, with different protocols, procedures, and operating many different types of radio systems on various bands. The recommended solutions are based on carefully coordinated planning and technology deployments:

- Adoption of common communications planning practices for daily and emergency operations by public safety agencies.

- Frequent exercises on the set up of interoperable radio communications under emergency situations.

- Instituting a statewide communications manager to oversee all facets of the common plan implementation.

- Exchange of existing ADOT VHF mobile radio channels with ADOT's partners

- Enabling of the national Interagency Radio System channel on ADOT radios

- Additional channels for ADOT districts

- Enforced adherence to communications plans or channel assignments

- Highway contractors to be provided ADOT-compatible VHF radios and access to repeaters

- Periodic updates of common plans and protocols of all partner agencies

- Common mnemonics, acronyms, and channel identifiers between ADOT and DPS

- Regional, short-term interoperability with ADOT partners within the Phoenix Construction and Maintenance District through cross-patching technologies.

- Telephone ring-down circuits between ADOT's Phoenix TOC and the dispatch centers of ADOT's core partners

The total planning-level estimated cost of the Goal IV actions is $84,000.

Pilot Projects: Operational Recommendations

To begin advancing toward the stated interoperability goals, five low-cost pilot projects, consistent with the recommended action items, are recommended. Each of the projects constitutes a test of a recommended solution and moves ADOT along the path toward short- and medium-term improvements in statewide interoperability. These pilot projects, listed below, address interoperability for ADOT Highways Division (ITD), for MVD, and for its core partner – DPS.

1. Expand VHF Infrastructure-Independent interagency interoperability for ADOT mobile radios across the I-40 corridor (under $5,000).

2. Reprogram MVD mobile radios with ADOT VHF statewide channels, and set up emergency after-hours access to the TOC dispatch center for MVD (under $5,000).

3. Install "hard" cross-links on the TOC console between specific 800 MHz Maintenance talk groups, and adjacent district VHF Maintenance radio channels (under $50,000).

4. Install low-cost VHF mobile radios in DPS Highway Patrol vehicles for all squads that operate along I-40 (under $100,000).

5. Provide dispatch console gateways to link DPS channels, to ADOT's VHF and 800 MHz Maintenance radio systems (under $100,000).